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LETTER SYMBOLS AND ABBREVIATIONS FOR ELECTRON TUBES

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0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 30 August 1969, after the draft finalized by the Electron Tubes and Valves Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard deals with the letter symbols and abbreviations to be used for electron tubes by manufacturers in their catalogues and in other technical literature. The main purpose of this standard is to enable the technical characteristics of the manufacturers' products to be described to their customers, and it is in this field that the standard is expected to prove most useful.

0.2.1 A system of letter symbols and abbreviations is also necessary for mathematical calculation concerning the operation of electron tubes and for allied technical descriptions.

0.3 In preparing this standard, endeavour has been made to unify the symbols peculiar to the electronic tube industry, and at the same time to ensure that they do not generally conflict with those used in wider fields of electric and electronic engineering. Similarly, every effort has been made to ensure that as far as possible symbols have been employed which have a significance common to all branches of engineering.

0.4 It is hoped that by means of this standard the interests of those who are concerned with electron tubes will be best served; they will obtain the advantages of accepted common symbols and at the same time avoid any inconvenience which might follow the adoption of specialized terms and symbols in conflict with those more generally employed.

0.5 It is recognized that the symbols and abbreviations included in this standard are not exhaustive. It is recommended that, as such needs arise, symbols and abbreviations should be chosen that they do not conflict with the generally accepted symbols and abbreviations set out in this standard. In this way new symbols and abbreviations consistent with this scheme, may achieve that general acceptance which is a sound prelude to standardization.

0.6 In choosing the symbols and abbreviations, the convenience of their production with standard printer's type as well as on a typewriter has been borne in mind.

0.7 This standard is largely based on B S. 1409:1950 'Letter symbols for electronic valves' issued by the British Standards Institution, and it also takes into account the practice followed in this country. Attempts have also been made to bring about uniformity as far as practicable with symbols adopted for semiconductor devices (IS : 3715-1966*).

0.8 This document covers general symbols for receiving tubes, transmitting and industrial tubes and cathode-ray tubes. Additional symbols for covering specific characteristics for different types of tubes are not covered at present and may be included either in the form of an amendment or future revision of this standard. Symbols for micro-wave tubes are also not covered by this standard.

0.9 This standard is one of a series of Indian Standards on electron tubes.

1. SCOPE

1.1 This standard covers the letter symbols and abbrevations used in connection with electron tubes.

2. GENERAL ASPECTS

2.1 Quantity Symbols — With the exception of symbols for voltage and current, the following general rules have been adopted:

a) Symbols relating to a tube itself are denoted by letters in small type (printer's 'lower case'); and

b) Symbols relating to associated circuitry are denoted by letters in capital type.

2.1.1 Values of voltage or current are denoted by letter symbols in capital type except that instantaneous values are denoted by letter symbols in small type.

Examples:

DC value of voltage	V_{DC}
RMS value of voltage	V_{rms}

*Letter symbols for semiconductor devices.

Average value of voltage	V_{av}
Instantaneous value of voltage	v

2.2 Subscript Symbols — Any qualification of a symbol is effected by means of a subscript and, where the subscript itself is qualified, this is indicated by a letter or figure in the same line as the subscript.

Examples:

First grid	g_1
Voltage on first grid	V_{g1}

NOTE — Where no confusion is likely to result, qualifying symbols shown as subscripts, may be in line with the main symbol for typewritten documents.

Example: Vg^1

2.2.1 When the subscript consists of two groups of symbols representing the terminal points between which a measurement is made the two groups need not normally be separated. If confusion is likely to occur the two groups may be separated by a comma.

Examples:

Capacitance between anode and first grid	$c_{a,g1}$
Insulation resistance between anode and cathode	r_{ak}

2.2.2 When two subscripts are used to qualify the same symbol, the second may be in brackets.

Example:

Root-mean-square value of voltage on an anode	$V_{a(rms)}$

3. ELECTRODE SYMBOLS

3.1 The electrodes and other elements, shall be denoted by the following symbols:

Anode	a
Cathode	k
Grid	g
Heater	h
Filament (emitting)	f
Fluorescent screen or other target	t
Internal conducting coating	m
External conducting coating forming an integral part of the tube (for example, metallizing, metal shell or can, partly or wholly covering the tube envelope)	M

Deflection plate	X or Y
Deflection rod	l
Internal shield	s
Beam forming plate	bp
Switch moving contact	cm
Switch fixed contact	cf
Primer (auxiliary electrode of cold cathode tubes to ensure safe triggering)	pr
Starter or trigger electrode of cold cathode tubes	st
Deflection electrode of a tuning indicator	d

3.2 Rules for Application of Electrode Symbols

3.2.1 To distinguish between electrodes of the same type the following rules shall apply

a) Subscripts need not be added if confusion is not likely to arise;

b) In multiple unit tubes (such as a triode-pentode) the respective electrodes may be distinguished by adding one of the following letters in capital letter as a subscript:

Triode	T
Tetrode	Q
Pentode	P
Hexode, heptode, etc	H
Rectifier	R
Detection diode	D

Examples covering one section of a multiple tube and two or more sections of a multiple tube:

Capacitance between triode gride and triode heater	C_{gTh}
Capacitance between triode grid and hexode grid	C_{gTgH}

3.2.2 Where there are two or more similar electrode systems which cannot be distinguished according to the type of tube or function, a printer's 'prime' or 'primes' or in the case of typewriting an apostrophe or apostrophes, shall be added; one for the first electrode system, two for the second electrode system and so on.

Example:

Anode voltage on the first section of detection diode	$V_{a'D}$

3.2.3 If more than one grid is present, forming part of the same section of the tube, the grids shall be distinguished by adding a figure as a subscript, the figure showing the sequence of grids counting from the cathode. A similar convention shall apply to a sequence of anodes.

3.2.4 Two or more internal shields or switch contacts (either moving or fixed) shall be distinguished by adding a figure as a subscript.

3.2.5 Secondary-emission electrodes shall be considered as cathodes. The primary cathode shall be denoted by *k*1 and the secondary cathodes by *k*2, *k*3, etc.

3.2.6 Where necessary, the polarity of the filament shall be indicated thus:

$$f_{(+)},\ f_{(-)}$$

3.2.7 Tappings on filaments or heaters shall be indicated by the use of the suffix 'tap'.

Example:

$$h_{tap}$$

3.3 A few examples on the use of electrode symbols specified are given below:

Full-wave rectifier (indirectly heated)	$h\ k\ a'a''$
Triode (directly heated)	$f\ g\ a$
VHF triode with special HF cathode connections	$h\ k\ k_{sig}\ g\ a$
Triode-pentode	$h\ k\ g\ T_a\ T_s$ (if any) $g_1\ g_2\ g_3\ aP$
Double pentode (separate cathodes)	$h\ k'\ g'_1\ g'_2\ g'_3\ a'$ $k''\ g''_1\ g''_2\ g''_3\ a''$
Double-diode tetrode (directly heated)	$f_{(+)} f_{(-)}$ a'D, a''D $g_1\ g_2$ a Q
Cathode-ray tuning indicator with triode secondary-emission photo multiplier	$h\ k\ g\ a\ t\ d$ $k_1\ k_2$ . . . a

4. TERMS AND SYMBOLS USED IN TUBE TECHNIQUES

4.1 The following general symbols shall be used:

Voltage	V
Current	I

	For the Device	*For the Associated Circuits*
Resistance	r	R
Reactance	x	X
Impedance	z	Z
Admittance	y	Y
Mutual inductance	m	M
Capacitance	c	C
Power	p	P

4.2 The following additional symbols shall be used in connection with tubes:

Brightness	B
Bandwidth	BW
Distortion	D
*n*th harmonic distortion	D_n
Total harmonic distortion	D_t
Noise factor	NF
Frequency	f
Power amplification	A_p
Voltage amplification	A_v
Sensitivity of cathode-ray tubes or photo tubes	S
Transformer ratio	n
Mutual conductance	g_m
Conversion conductance	g_c
Averaging time of currents of voltages	t_{av}
Bulb temperature	T_g
Ionization time	t_i
De-ionization time	t_{deion}
Recovery time	t_{rec}
Cathode heating time	t_h
Switching delay time	t_{sd}
Pulse duration	t_p
Amplification factor tube	μ
Length of light sector in a tuning indicator	l
Phase angle	ϕ

Efficiency	η
Wave length	λ
Pressure drop in radiator in millimetres of water	P_d
Required water flow for water cooling	q
Temperature	T
Temperature of anode or anode block	T_a
Ambient temperature	T_{amb}
Temperature of condensed mercury (at the cathode)	T_{Hg}
Inlet temperature of cooling water	T_{in}
Temperature of glass to metal seal	T_{gm}
Radiator temperature	T_{rad}
Outlet temperature of cooling water	T_{out}

4.3 The following subscripts shall also be used:

Battery or other source	b
Inverse (voltage)	inv
Ignition (voltage)	ign
Extinction (voltage)	ext
Input	in
Output	out
Modulation	mod
Stabilized	stab
Equivalent	eq
Signal	sig
Heterodyne	het
Surge (voltage or current)	sur
Total effective working load	L
Angle of flow	θ

4.4 The following abbreviations shall be used in connection with electron tubes:

Peak inverse voltage (rectifier)	PIV
Cross-modulation factor	CMF
Hum-modulation factor	HMF
Duty factor	DF
Pulse recurrence frequency	PRF

Top contact	TC
Side contact (when more than one exists, the abbreviation may be followed by a figure or other distinguishing symbol)	SC
Cathode-ray tube	CRT
Electrostatic focus	ESF
Electrostatic deflection	ESD
Magnetic focus	MF
Magnetic deflection	MD
Pin with an unspecified internal connection, which shall not be used for an external connection	ic
Pin with no internal connection	nc
No pin	np

5. LETTER SYMBOLS AND DESCRIPTIONS

5.0 A list of examples of symbols which shall be used with electron tubes are given below and in general has been compiled according to the convention laid down in this standard.

5.1 Voltages

DC voltage	V
DC anode voltage	V_a
DC anode voltage in cut-off condition	V_{ao}
DC voltage between cathode and heater	V_{kh}
DC voltage on fluorescent screen in cut-off condition	V_{to}
DC voltage on fluorescent screen	V_t
Voltage between anode and a starter	V_{a_st}
Supply voltage	V_b
Supply voltage to anode	$V_{b(a)}$
Voltage between two deflection plates of a cathode-ray tube	$V_{x_1x_2}$ or $V_{y_1y_2}$
Filament voltage (dc)	V_f
Grid voltage (dc)	V_g
Grid valtage in cut-off condition	V_{go}
Ignition voltage (voltage necessary for breakdown to the concerning electrode)	V_{ign}

Prime voltage of a cold cathode tube	V_{pr}
Starter voltage of a cold cathode tube	V_{st}
Oscillator voltage	V_{osc}
Arc voltage	V_{arc}
Alternating voltage (rms)	V_{rms}
RMS value of filament or heater voltage	$V_{f(rms)}$
RMS value of heater voltage	$V_{h(rms)}$
Instantaneous voltage	v
Peak voltage	V_M
Peak inverse voltage	V_{inv}

NOTE — Unless otherwise stated, the voltages on the various electrodes shall be with respect to the cathode in the case of indirectly heated tubes, and with respect to the negative side of the filament in the case of directly heated tubes.

5.2 Currents

DC current	I
DC anode current	I_a
Zero signal dc anode current	I_{ao}
Current of a detection diode	I_D
Filament current (dc)	I_f
DC cathode current	I_k
Grid current (dc)	I_g
Signal grid current	$I_{g(sig)}$
Arc current	I_{arc}
Ignitor current	I_{igr}
Primer current of a cold cathode tube	I_{pr}
Saturation current	I_{sat}
Starter current required to initiate the main discharge of a cold cathode tube	I_{st-ign}
Emission current	I_e
Current to fluorescent screen	I_t
Average dc current supplied by a rectifying tube	I_o
Dark current of photo-tubes	I_{ao}
Alternating current	I_{rms}
RMS value of filament or heater current	$I_{f(rms)}$
RMS value of heater current	$I_{h(rms)}$

Instantaneous current	i
Peak current	I_M
Surge current of rectifying tubes, thyratrons and ignitrons	I_{sur}

NOTE — The positive electrical current is directed opposite to the direction of the electron current.

5.3 Powers

Anode dissipation	P_a
Grid dissipation	P_g
Input power to the tube	P_{in}
Dissipation of a fluorescent screen	P_t
Driving power	$P_{g\ (sig)}$
Modulating power	P_{mod}
Output power	P_{out}

5.4 Capacitances

Capacitance between the anode and all other electrodes and shields except the control grid (of the same section only)	c_a
Capacitance between anode and grid (all other electrodes and shields earthed)	c_{ag}
Capacitance between anode and cathode (all other electrodes and shields not connected to cathode being earthed)	c_{ak}
Capacitance between a deflection plate or electrode and all other electrodes of a tuning indicator	c_d
Capacitance between two deflecting plates	$c_{x_1x_2}$, $c_{y_1y_2}$
Inter-sectional capacitance between two deflecting plates (applicable for double beam cathode-ray tubes)	$c_{x'_1x'_2}$, $c_{y'_1y'_2}$, $c_{x''_1x''_2}$, $c_{y''_1y''_2}$, $c_{y'_1y''_2}$, $c_{y''_1y'_2}$, etc.
Input capacitance of a smoothing filter	C_{filt}
Capacitance between a grid and all other electrodes and shields earthed	$c_{g_1g_2}$
Capacitance between a grid and the cathode (all other electrodes and shields not connected to the cathode being earthed)	c_{gk}

Capacitance between the cathode and all other *electrodes*	c_k
Capacitance between cathode and heater	c_{kh}

5.5 Resistances

External resistor in anode lead	R_a
Effective resistance of a push-pull amplifier (anode to anode)	R_{aa}
Total effective load resistance	R_L
Resistor between anode and starter of a cold cathode tube	$R_{a\text{-}st}$
External resistor in the lead of a deflecting electrode of a tuning indicator	R_d
Equivalent noise resistance	R_{eq}
External resistor in a grid lead	R_g
Anode resistance of tube	r_a
Resistor in a cathode lead	R_k
External resistor between cathode and heater	R_{kh}
Insulation resistance between cathode and heater of a tube	r_{kh}
External resistor in the starter lead of a cold cathode tube	R_{st}
External resistor in the primer lead of a cold cathode tube	R_{pr}
Protective resistor in the anode lead of a rectifying tube	R_s

5.6 Impedances — Wherever applicable symbols for impedances may be obtained by substituting 'Z' or 'z' for 'R' or 'r' in the symbols for resistances and changing the term resistances to impedances.